US-PAT-NO: 6463172

DOCUMENT-IDENTIFIER: US 6463172 B1
See image for Certificate of Correction

TITLE: Image processing method and apparatus

DATE-ISSUED: October 8, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Yoshimura; Megumi	Ryugasaki	N/A	N/A	JP

US-CL-CURRENT: 382/162, 358/540 , 382/284

ABSTRACT:

When performing image synthesis, in which a plurality of images having different color tones are combined, or when converting the contrast of an image, the prior art is such that a user must convert pixel levels manually. Consequently, it is required that the user have thorough knowledge of the constitution of the image data to undergo the level conversion and of image processing techniques in general. This means that the conversion cannot be performed by anyone in simple fashion. In accordance with the present invention, a conversion table is created automatically based upon the color distribution of first image data in such a manner that the color tone of second

image data is made to approach that of the first image data, and the second
image data resulting from a pixel level conversion by this conversion table is
combined with the first image data, whereby there is obtained a natural
composite image. In another aspect, an appropriate contrast conversion can be
performed with ease by performing a pixel level conversion in accordance with a
conversion table created based upon a pixel level distribution of image data.

11 Claims, 16 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 12

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Detailed Description Text - DETX (4):
This embodiment is characterized in that after an appropriate level
conversion is performed automatically in regard to two color images displayed
on a display unit, for example, in such a manner that the **color tone** of the
image data of one **image (which shall be referred to as a "target image**") is
made to conform to the **color tone** of the other image (which shall be referred
to as a "reference image") in response to a designation made by the user via a
pointing device, the two images are combined.

Detailed Description Text - DETX (6):

The CPU 1, which is in the form of a microprocessor, for example, controls the operation of the foregoing components. The ROM 2 stores a system program 210 and an image application program 220, which is for executing various image processing. The image application program 220 includes a color tone conversion program 221, which is a characterizing feature of the present invention, and an image synthesis program 222. The RAM 3 includes a reference image data area 301 for storing an image serving as a reference for **color tone, a target image** data area 302 for storing a **target image** whose **color tone** is to be converted, a histogram area 303 for storing a histogram of the reference image, a conversion table area 304 which stores a conversion table for converting the **color tone of the target image,** and an area 305 used for other processing and as a work area.

Detailed Description Text - DETX (16):

More specifically, on the basis of the histograms of the reference image, the inclination of each color in the reference image data, for example the fact that there are few B components and many R components, is recognized, and the conversion tables are created so as to reflect this inclination. Accordingly, as a result of subjecting the **target image** data to a **color tone** conversion using these conversion tables, it is possible to make the conversion in such a manner that the B components are reduced to a quantity similar to that of the reference image data. This **color tone of the**

target image thus can be made to approach that of the reference image.

Detailed Description Text - DETX (19):

In the flowchart of FIG. 4, **image data (target image** data) whose **color tone** is desired to be converted is called to the **target image** data area 302 at step S101. When the start of color tone conversion processing based upon the color tone conversion program 221 is commanded in accordance with execution of the image application program 220, image data (reference image data) whose color tone is the reference is called to the reference image data area 301 at step S102. It is of course permissible to reverse the order of steps S101 and S102, i.e., to start the color tone conversion processing after the reference image data is called. In either case, when **color tone** conversion processing is executed in this embodiment, the image data that has been called to the reference image data area 301 and **target image** data area 302 is stored to establish the necessary information.

Detailed Description Text - DETX (30):

When all pixel values have thus been converted in accordance with the conversion tables, an image whose color tone is close to that of the reference image is obtained. In other words, the **color tone of the target image** can be made to approach that of the reference image.

Detailed Description Text - DETX (31):

The **target image** obtained by the **color tone** conversion and the reference image are combined at step S108 by starting up the image synthesis program by the image application program 220. Since the **color tones of the target image** and reference image are near to each other in this case, a more natural composite image is obtained.

Detailed Description Text - DETX (32):

It should be noted that the image synthesis processing at step S108 need be performed only as needed. For example, it is possible as a matter of course for the **target image** obtained by the **color tone** conversion to be saved in the area 305 beforehand and combined with another image specified by the user or combined with two or more images which include a reference image, by way of example.

Detailed Description Text - DETX (35):

In this embodiment, color **image data, which is similar to the target image** data, composed of pixel levels of each and every color component is described as the reference image data, namely the data referred to in order to convert the **color tone of the target image** data. However, vector data of a color or a color table in which values representing colors have been written may serve as the data referred to in order to perform the color tone conversion. Similarly, the target data that is to undergo the color tone

conversion is not limited to
image data but may be data other than image data, such as vector data.

Detailed Description Text - DETX (42):

In the second embodiment, the ROM 2 stores the system program 210 and the image application program 220 for executing various image processing. The image application program 220 includes a pixel level conversion program 223, which is a characterizing feature of this embodiment. The RAM 3 includes the image data area 302 for storing a **target image** whose **color tone** is to be converted, the histogram area 303 for storing a histogram of image data, the conversion table area 304 which stores a conversion table for converting the levels of the image data, and the area 305 used for other processing and as a work area.

US-PAT-NO: 6396599

DOCUMENT-IDENTIFIER: US 6396599 B1
See image for Certificate of Correction

TITLE: Method and apparatus for modifying a portion of an image in accordance with colorimetric parameters

DATE-ISSUED: May 28, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Patton; David L.	Webster	NY	N/A	N/A
Fredlund; John R.	Rochester	NY	N/A	N/A
Buhr; John D.	Webster	NY	N/A	N/A

US-CL-CURRENT: 358/1.9, 358/518 , **382/164**

ABSTRACT:

A method and apparatus for modifying images. The method includes the steps of analyzing a digital image file of an image so as to identify at least one predetermined colorimetric parameter; and automatically modifying that portion of said image having said at least one predetermined colorimetric parameter to a second predetermined colormetric parameter so as to produce a modified digital image.

19 Claims, 2 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 2

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Brief Summary Text - BSTX (4):

Color negative/positive photographic systems in use today are designed to produce pleasing prints for most of the people in a target population. The print appearance includes both pleasing **tone and color** reproduction to produce colorful prints with good contrast, and particularly excellent **skin** tone reproduction. Typically, existing photo systems are designed to be optimized for a particular skin type and preference, for example, Caucasian, Oriental, Asian, Indian, and/or Black. Photographic film, paper, and printer sets-ups are generally designed for providing pleasing color for a particular market segment. In taking photographs of an individual of a first skin tone type with a system designed for a second skin tone type, the skin tones of the first skin tone type will appear undesirable. For example, in a system designed for Caucasians, individuals having a darker skin tone will result in the darker skin tones appearing compressed. This often results in the facial features being lost in an overly dark representation.

Detailed Description Text - DETX (5):

When the algorithm alters the default skin tone reproduction, the adjustment may consist of a print density or color balance bias, or more preferred, the application of a matrix or 3D table of parameters to the digital capture image. The 3D table of parameters is the preferred embodiment because it allows skin tones to be altered without altering the remaining colors in the image. It is also possible to alter the **color reproduction of the skin tones** within the scene by applying a matrix only if the pixel value is a **skin** tone.

Detailed Description Text - DETX (6):

The preferred adjustment will often consist of a reduction in **skin** tone colorfulness and a reduction in the contrast of the reproduction in **color region of the skin tones**. Generally, it is preferred to maintain a neutral gray scale in the image while adjusting the skin tones to their preferred colorimetric position. However, any adjustment preferred by the customer may be implemented.

Current US Cross Reference Classification - CCXR (2):

382/164

US-PAT-NO: 5333069

DOCUMENT-IDENTIFIER: US 5333069 A

TITLE: Technique for use in conjunction with an imaging system for providing an appearance match between two images and for calibrating the system thereto

DATE-ISSUED: July 26, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Spence; John P.	Webster	NY	N/A	N/A

US-CL-CURRENT: 358/517, 358/518

ABSTRACT:

Apparatus, and associated methods employed therein, for objectively providing an accurate appearance match between two depictions of a common images produced by two imaging systems (e.g. a target image (170) produced by one such system (160), e.g. a press sheet (178) generated by a printing press (168), which is to be matched by a replica image (150) produced by another such system (140), e.g. a proof (153) generated by a direct digital color halftone proofing system (143)) and thereby calibrate the performance of one imaging system, e.g. the proofing system, to that of the

other system, e.g. the printing press. Specifically, measurement data, such as illustratively colorimetric CIELAB L*a*b* measurements, is obtained for the same portions of the press sheet and proof. This data is acquired in or transformed into a color space which encodes color information in a pre-defined manner that approximates human color perception. Thereafter, through use of a pre-determined model of the, e.g., proofing system, incorporated into pre-defined matching principles which objectively and quantitatively define an accurate appearance match between the depictions produced by both systems, operational settings for the proofing system, such as solid area densities and tint dot areas, are determined which will calibrate the response of the proofing system to that of the press. Consequently, tone and color rendition produced by the proofing system is modified to provide an accurate appearance match to that obtained, from a common image source, on the press, given judgmental color preferences of a human observer and performance limitations of the proofing system.

31 Claims, 18 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 16

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Brief Summary Text - BSTX (20):

However, a proofing system with variable **tone and color** reproduction characteristics often presents the technician with an enormous number of different possible combinations of the settings. For example, for the system described in the '459 Cowan et al patent, the solid area density and dot size can be set for each of the four process colors (C, Y, M and K) at any of 20 different density levels and at any of 15 different dot size settings. For the DDCP system described in the '940 Spence application, the number of solid area density settings is considerably larger, with, e.g., the number of dot size settings alone (comprising specification of several control points) numbering well into the thousands. In view of the resulting huge number of potential combinations of settings, an experienced color technician often needs to run and separately analyze quite a few successive proofs in order to **select a suitable solid area** density and halftone dot size setting (or an entire tone reproduction curve shape) for each different colorant in order to achieve an acceptable match between the proof **image and a target image** and thereby calibrate the proofing system to the target imaging system. Moreover, additional time is consumed whenever the technician is forced to resort to trial-and-error experimentation or, in a worst case scenario, guesswork: either merely as a result of iterating through a very large number of possible combinations to discern the performance

inter-relationships of the proofing system and/or by incorrectly relying on intuition and initially iterating away from a proper operating condition. An example of the latter situation can occur where the technician, based upon his own intuition, views a proof **image against a target image** and decides that the yellow content in the proof image needs to be increased. While the technician may decide to initially increase the halftone dot size for the yellow colorant, the proper operating condition may instead involve reducing the halftone dot sizes for all the colorants but reducing the halftone dot size for yellow less than that for each of the other colorants.

US-PAT-NO: 6594388

DOCUMENT-IDENTIFIER: US 6594388 B1

TITLE: Color image reproduction of scenes with preferential color mapping and scene-dependent tone scaling

DATE-ISSUED: July 15, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Gindele; Edward B.	Rochester	NY	N/A	N/A
Topfer; Karin	Rochester	NY	N/A	N/A
Buhr; John D.	Fairport	NY	N/A	N/A
Woolfe; Geoffrey J.	Penfield	NY	N/A	N/A
Gallagher; Andrew C.	Rochester	NY	N/A	N/A

US-CL-CURRENT: **382/167**, 358/520

ABSTRACT:

A method for enhancing the hue and lightness characteristics of a digital color image, the digital color image having pixel values from which digital luminance and color difference values can be deduced, includes the steps of: deducing digital luminance and digital color difference values for pixels of

the digital color image; using the pixels of the digital color image to
calculate an image dependent transform; using the image dependent transform to
modify the digital luminance values for pixels of the digital color image to
form modified luminance values; calculating a color transform that modifies the
original digital color difference values in a manner that consistently and
smoothly moves the values toward or away from predetermined digital color
difference values; and using the color transform to modify the original color
difference values for pixels of the digital color image to produce modified
color difference values.

54 Claims, 27 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 20

---------- KWIC ---------

Brief Summary Text - BSTX (17):
This invention combines preferred color reproduction with scene-dependent
tone scaling. As a result, higher color quality can be obtained compared with
using any of the two algorithms in isolation. Preferred color mappings
encompass generally accurate hue reproduction apart from a few **selected regions**
of color space, where hues are modified in designed fashion, in order to
produce reproductions that are highly preferred by

customers. In addition, the colorfulness and the tone scale of the reproduction can be modified to produce images according to viewer preference. In preferred **color manipulations, tone** scale functions are usually implemented as a global transformation that do not take into account the dynamic range of the scenes. As a result, not all scene tones in high-dynamic range scenes can be reproduced on limited dynamic range output devices and media as viewers see them. This shortcoming of preferred color manipulations can be addressed by scene-dependent tone scaling algorithms that map scene tones into a range that can be reproduced by the intended output medium or device. In order to retain the advantages of hue control that are part of the preferred **color manipulations, the tone** scale manipulations must be implemented in a way that leaves hue unaltered. This can be achieved by applying the tone scale function to the luminance channel of a luminance/color difference space.

Current US Original Classification - CCOR (1):
382/167

US-PAT-NO: 5333069

DOCUMENT-IDENTIFIER: US 5333069 A

TITLE: Technique for use in conjunction with an imaging system for providing an appearance match between two images and for calibrating the system thereto

DATE-ISSUED: July 26, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Spence; John P.	Webster	NY	N/A	N/A

US-CL-CURRENT: 358/517, 358/518

ABSTRACT:

Apparatus, and associated methods employed therein, for objectively providing an accurate appearance match between two depictions of a common images produced by two imaging systems (e.g. a target image (170) produced by one such system (160), e.g. a press sheet (178) generated by a printing press (168), which is to be matched by a replica image (150) produced by another such system (140), e.g. a proof (153) generated by a direct digital color halftone proofing system (143)) and thereby calibrate the performance of one imaging system, e.g. the proofing system, to that of the

other system, e.g. the printing press. Specifically, measurement data, such as illustratively colorimetric CIELAB L*a*b* measurements, is obtained for the same portions of the press sheet and proof. This data is acquired in or transformed into a color space which encodes color information in a pre-defined manner that approximates human color perception. Thereafter, through use of a pre-determined model of the, e.g., proofing system, incorporated into pre-defined matching principles which objectively and quantitatively define an accurate appearance match between the depictions produced by both systems, operational settings for the proofing system, such as solid area densities and tint dot areas, are determined which will calibrate the response of the proofing system to that of the press. Consequently, tone and color rendition produced by the proofing system is modified to provide an accurate appearance match to that obtained, from a common image source, on the press, given judgmental color preferences of a human observer and performance limitations of the proofing system.

31 Claims, 18 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 16

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Brief Summary Text - BSTX (18):

Unfortunately, calibrating a proofing system tends to consume an inordinate amount of time as well as require a very high level of skill. In this regard, a color technician is required to possess a substantial level of skill and expertise not only to judge color differences between a proof image and a target image therefor but also to fully appreciate performance inter-relationships between the colors that appear on the proof image and corresponding colors that will appear on the target image. Consequently, the technician not only must recognize a color difference and decide which specific **colors to match but also, where the tone and color** reproduction characteristics of the proofing system can be varied, determine the proper variations in these characteristics in order to achieve an acceptable match between the proof **image and the target image** and then set the proofing system accordingly.

Brief Summary Text - BSTX (26):

In particular, it has been known for some time that human color perception, including mental judgment, exhibits differing sensitivities for different colors. Given this, human observers will be much more acutely aware of what would amount to minor color differences, such as differences in so-called "memory" colors (e.g., greens and flesh tones), in certain pictorial contexts than in others. Accordingly, a color difference that would simply be

noticeable, if at all, in some contexts would be highly objectionable in others. For example, people are acutely aware of very small differences in flesh tones. A viewer will likely object to a human face that appears too blue or green, while merely noticing, if at all, and certainly not objecting to a tablecloth or blanket that exhibited the same variation. Thus, an effective color balance needs to account for the preferences inherent in human color perception. Specifically, if a **target image** is compared side-by-side to an accurate proof image thereof, a viewer should reach the conclusion that the proof image in effect has a good appearance, i.e. flesh **tones appear as they should as well as do other colors** given the context of the image thereon. In this instance, the relative coloration throughout the proof image is pleasing even though the specific hues in the proof image will not necessarily identically match those in the target image. Such a visually pleasing match between a proof image and a target image will hereinafter be referred to as an "appearance match".

Detailed Description Text - DETX (156):

By now it should be readily apparent to those skilled in the art that the broad principles of my invention are applicable to objectively obtaining an appearance match between two of a wide variety of different imaging systems and therethrough to calibrate the tone and color response characteristics of one of

these systems to those of another such system. By doing so, a replica image, such as a proof as described above, made by one of these systems, e.g. a proofer, will be an accurate appearance match to a desired target image, such as a press sheet, of that particular image but made by the other such system, such as illustratively a printing press. In order to calibrate any such system to another, the matching principles set forth above, in all likelihood, would need to be appropriately changed based on color response of the two systems and associated imaging media and the reproducible color gamuts obtainable therethrough as well as on the judgmental response of the observer. For example, rather than matching the three-color overprint solid achromatic value and tint achromatic and chromatic coordinates and two-color (for red and green) hue angles as described above, then, depending on the characteristics of the imaging systems, full scale three-color overprint color coordinate matching (solid included) or alternatively full scale three-color overprint achromatic scaling coupled with red and green hue angle matching could be used. Furthermore, as different "replica" imaging systems and imaging media are used, the specific model that is used to represent the "replica" imaging system would also change in order to accurately characterize its response to changes in its operating conditions or settings. Such a change, for a localized linearized model, might entail use of different empirically determined sensitivity coefficients and/or different linearized equations

given the process colorants
that are to be used. Furthermore, if a
increasingly complicated model, such as
quadratic, cubic or other localized fits or even
non-localized modeling, were
to be used, then the modeling equations and
associated coefficients would
change accordingly. Regardless of the specific
model to be used, that model
would be combined with appearance based matching
principles in order to modify
tone and color rendition produced in the replica
according to these principles
and the **tone and color** rendition obtained from a
common source in the target so
that, given the judgmental preferences of the
observer and any performance
limitations of the replica imaging system, the
operational settings (and
thereby the **tone and color** reproduction
characteristics) of the replica imaging
system would be altered in a manner which will
produce a replica image that is
an accurate appearance match to the **target image**.
By combining the model and
matching principles through feedback-based
equations, a succession of replica
images could be made for each target image so that
the recommended process
color values, either in relative (i.e. changes) or
absolute magnitude terms,
will iteratively converge, within pre-defined
convergence limits, to final
values. As such, measurements would be taken of
corresponding portions of a
target image and the replica and fed back as input
into the feedback-based
equations to generate a new set of process color
values. A new replica image
would be generated using these values with

appropriate measurements being taken of this image, and so on until the values appropriately converged. I fully expect that my inventive technique will likely provide operational settings that will produce an accurate objective appearance match, across many different imaging systems, in significantly less time and cost and requiring substantially less user expertise than trial-and-error methods, currently in use, or even quantified overall colorimetric techniques. Although appreciable time reductions occur even with use of relatively inaccurate models, convergence will occur in even less time (i.e. at an increased rate) and hence through use of fewer replica images as increasingly accurate models are used of the replica imaging system.

US-PAT-NO: 5130935

DOCUMENT-IDENTIFIER: US 5130935 A
See image for Certificate of Correction

TITLE: Color image processing apparatus for extracting image data having predetermined color information from among inputted image data and for correcting inputted image data in response to the extracted image data

DATE-ISSUED: July 14, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Takiguchi; Hideo	Yokohama	N/A	N/A	JP

US-CL-CURRENT: **382/167**, 356/407 , 358/518

ABSTRACT:

A color image processing apparatus generates color image data, measures the quantity of the image data within a predetermined region of color space, obtains a representative color value for the image data within that region, and corrects the color image data based on the representative value and the measured quantity.

The number of image data which exist within a

predetermined region on a (u,v), chromaticity diagram and which are among input color image data is counted. When the counted number is smaller than a predetermined value, the correcting operation is not executed. The difference between a predetermined coordinate point and a coordinate point at which the largest counted number of image data exist is obtained, and by the obtained distance either all the image data or the image data within the predetermined region are corrected.

30 Claims, 12 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 8

---------- KWIC ---------

Parent Case Text - PCTX (9):

According to another aspect of the present invention, a skin color, which is a most distinguishing color among colors of an original, is made an object of processing. If a **skin** color exceeding in quantity a certain value is included in an original, a correction quantity is determined to automatically perform **color correction of the tone** of an overall original image, with emphasis upon a **skin** color.

Detailed Description Text - DETX (32):

As seen from the above description of the

embodiments, by shifting a pixel location where pixels having a **skin** color of an image exist at a maximum to another pixel location of a **skin color having a proper tone**, it is possible to automatically perform color correction of a **skin** color to a proper **skin** color. Further, by incorporating the region outside the skin color region as an object region to be corrected, a smooth color correction can be achieved.

Current US Original Classification - CCOR (1):
382/167